Continental J. Agricultural Science 4: 1 - 6, 2010 ISSN: 2141 - 4203
 http://www.wiloludjournal.com

# DEVELOPMENT AND QUALITY EVALUATION OF WEANING FOOD FORTIFIED WITH AFRICAN YAM BEAN *(SPHENOSTYLIS STENOCARPA)* FLOUR.

Okoye J.I.[1], Ezigbo, V. O.[2] And Animalu, I.L.[3]
[1]Department of Food Science and Technology and [3]Department of Microbiology, Madonna University, Elele Campus, P.M.B 48, Elele, Rivers State, Nigeria and [2.] Department of Industrial Chemistry, Anambra State University, P. M. B 02, Uli Anambra State, Nigeria.

**ABSTRACT**
The use of sorghum and African yam bean blended flours in the preparation of weaning food formulations was studied. The sorghum flour (SF) was composite with African yam bean flour (AYBF) at the levels of 10%, 20%, 30%, 40% and 50%. The weaning food formulations produced from the flour blends were analysed for their nutritional and sensory qualities using standard methods. The nutritional composition of the samples showed that the protein content of the formulations increased with increasing supplementation with African yam bean flour from 8.64% in 90:10 (SF:AYBF) to 13.44% in 50:50 (SF:AYBF) samples, while carbohydrate decreased. In the same vein, the energy content of the formulations increased gradually as the level of fortification with African yam bean flour increased from 368.98KJ in 90:10 (SF:AYBF) to 382.98KJ in 50:50 (SF:AYBF). The sensory evaluation carried out on different samples of weaning food formulation after reconstitution into gruel with boiling water showed that the formulation made from 100% sorghum flour used as control was the most acceptable by the judges and was also significantly different ($p<0.05$) from the other samples in flavour and texture. However, the formulation fortified with 50% African yam bean flour was scored highest in colour.

**KEYWORDS:** Weaning food, fortification, sorghum flour, African yam bean flour, quality assessment.

## INTRODUCTION

Cereals and legumes, individually or as composites, are the main source of nutrients for weaning children in developing countries (Chavan and Kadam, 1989). Weaning foods commonly used in Nigeria are composed largely of sorghum *(Sorghum bicolor)* with a limited amount of dried –milk powder. However, such mixtures have been shown to be poor in protein content and quality (Achi, 2005).

The fortification of weaning foods with a variety of inexpensive vegetable proteins from legumes, nuts and oilseeds has received considerable attention from nutritionists and food scientists in several sub-saharan African countries (Uzogara *et al;* 1990). This is because these grain legumes and oilseeds are relatively high in lysine, an essential amino acid deficient in most cereals (Nout, 1993). Whole legumes generally contain high amount of protein compared to other foods of plant origin (FAO, 2005). Ideally, the ingredients for low cost complementary foods must be derived from dietary staples that are available and affordable in the region of interest.

African yam bean *(Sphenostylis stenocarpa)* is one of the edible grain legumes widely cultivated in Africa that is used for human and animal nutrition (Eke, 2002). Like most grain legumes cultivated in African, African yam bean is rich in protein, carbohydrate, vitamins and minerals (Iwuoha and Eke, 1996). The protein of African yam bean is made up of over 32% essential amino acids, with lysine and leucine being predominant (Onyenekwe *et al;* 2000). The supplementation of cereal-based weaning foods with adequately processed African yam bean flour would help to improve their protein content and quality. It could also help to extend the use of this lesser known and utilized legume in a number of food preparations especially in developing countries for human consumption. The purpose of this study was to examine the nutritional and sensory qualities of weaning food formulations fortified with African yam bean flour at different levels of substitution.

## MATERIALS AND METHODS

White variety of sorghum *(Sorghum vulgare)* and African yam bean *(Sphenostylis stenocarpa)* used for this study were procured from local markets in Owerri and Umuahia, respectively. This research work was carried out in Department of Food Science and Technology, Madonna University, Elele, Nigeria, in August, 2008.

### Preparation of Sorghum Flour

The sorghum flour was prepared according to the method described by Ihekoronye (1999). During preparation, two kilograms of sorghum grains, which were free from dirts, damaged and contaminated grains were weighed, cleaned and soaked in tap water for 18h. During soaking, the water was changed occasionally at intervals of 6h to prevent fermentation.

Thereafter, the soaked grains were drained and wet milled (attrition mill) with tap water into fine slurry. The resulting slurry was sieved (muslin cloth) and allowed to sediment for 10h after which it was decanted. The sedimented and decanted slurry was eventually dewatered, spread on the trays and dried in the tray dryer ($60^0$C, 8h). After that, the dried cake obtained was milled (attrition mill) and sieved through a 500µm mesh sieve. The sorghum flour produced was finally packaged in sealed polyethylene bags for blending and preparation of weaning food formulations.

### Preparation of African Yam bean Flour

The African yam bean flour was prepared according to the method described by Eneche (2006). During preparation, two kilograms of African yam bean seeds which were free from foreign particles such as stones, leaves and sticks as well as damaged and contaminated seeds were weighed, cleaned and soaked in tap water containing 0.1% sodium metabisulphite ($NaHS0_3$) for 12h. Thereafter, the soaked seeds were manually dehulled, drained and boiled ($100^0$C, 20 min). The dehulled and boiled seeds were spread on the trays and dried in the tray dryer ($60^0$C, 10h). After that, the dried seeds were immediately milled (attrition mill) and sieved through a 500µm mesh sieve. The cooked African yam bean flour produced was finally packaged in sealed polyethylene bags for blending and preparation of weaning food formulations.

### Preparation of Weaning Food Formulations

The weaning food formulations were prepared according to the method described by Agu and Aluyah (2004). During preparation, the sorghum flour (SF) was composite with African yam bean flour (AYBF) at the levels of 10%, 20%, 30%, 40% and 50% in a Kenwood mixer (Model NX806 H) to obtain different samples of sorghum / African yam bean blended flour. After that, 5% vitamin mix, 5% mineral mix, 2% salt and 5% sucrose (sugar) were added to each of the flour blends and mixed thoroughly in a mixer (Model A409 G) for 10 min to produce fortified weaning food formulations. Thereafter, the fortified weaning food formulations obtained were individually packaged in sealed polyethylene bags and kept at ambient temperature conditions until further analysis. In addition, the weaning food formulation made with 100% sorghum flour was similarly prepared as reference. The various samples of weaning food formulation prepared from sorghum / African yam bean blended flours are shown in Table 1.

### Chemical Analysis

The moisture, protein, fat, ash and fibre contents of each of the weaning food formulations were determined according the methods of AOAC (1995). The carbohydrate was determined by difference Okaka *et al;* (2000). The food energy was calculated from proximate composition according to the standard method described by Onwuka (2005). All determinations were carried out in triplicates.

### Sensory Evaluation

The weaning food formulation prepared from 100% sorghum flour and the fortified samples with different levels of substitution with African yam bean flour were individually prepared into gruel with boiling water. During preparation, 20g of each sample was suspended with 50ml of tap water in a small plastic bowl. Thereafter, 60ml of boiling water was added to each of the suspended sample to produce hot gruel. After preparation, the various samples of gruel produced were scored by a panel of fifteen untrained judges drawn from the University Community for attributes of colour, flavour, texture and overall acceptability on a hedonic scale of 1-9 where 1 = dislike extremely and 9 = like extremely (Iwe, 2001).

**Statistical Analysis**

The means and standard deviations of all the data generated after the analyses were calculated. The results were subjected to Ducan multiple range test to detect significant differences ($p<0.05$) among the sample values (Powers, 1998). The turkey test was used in separating significant means.

**RESULTS AND DISCUSSION**

The proximate composition of weaning food formulations prepared from sorghum / African yam bean flour blends are shown in Table 2. The moisture content of the weaning food formulations was significantly different from each other ($p<0.05$). They were also higher than those reported by Jipara *et al;* (2001). The protein content of the formulations ranged from 6.84% to 13.44%. The differences were observed because the protein content of the formulations increased as the level of fortification with African yam bean flour increased. However, the result is in agreement with the report of Nnam (2001). This addition effect was also observed for ash and fibre contents of the formulations. In other words, the ash and fibre contents of the formulations increased steadily with increasing supplementation with African yam bean flour. The results also showed that African yam beans are good sources of ash and fibre (Enwere, 1998). However, the opposite effect (subtraction effect) was observed for fat and carbohydrate contents of the formulations. The fat and carbohydrate contents of the formulations decreased readily with increasing content of African yam bean flour. They were also similar with those reported by Treche and Mbome (1999). The energy content of the formulations ranged from 362.10KJ to 382.98KJ. The energy content of the formulations was significantly different from each other ($p<0.05$). They were also higher than those reported by Okoye *et al;* (2007). Generally, the use of these products for feeding infants and weaning children should be encouraged because they contain both salt and sugar which are the major ingredients of oral rehydration therapy. However, infants and weaning children placed on these products may not need oral rehydration therapy solution.

The results of the sensory evaluation performed on different samples of reconstituted weaning food gruel made from sorghum / African yam bean flour blends are shown in Table 3. The various samples of gruel prepared from different weaning food formulations were generally scored high in all the sensory attributes evaluated. However, the gruel prepared from the formulation made from 100% sorghum flour used as control was most acceptable by the judges and was also significantly different ($p<0.05$) from the other samples fortified with African yam bean flour at different proportions in flavour and texture. The differences could be attributed to the unique quality of sorghum flour in the preparation of weaning food formulations (Thaoge *et al;* 2003). In addition, the result also indicated that the gruel made from the formulation fortified with 50% African yam bean flour had better colour than the other samples. The improvement in colour of the sample could be due to the ability of African yam bean products to retain some of the colour pigments found naturally in their seeds on exposure to heat during processing (Banigo *et al;* 2004).

**Table 1:** Samples of Weaning Food Formulation

| **Samples** | **SF(%)** | **AYBF(%)** |
|---|---|---|
| A | 100 | 0 |
| B | 90 | 10 |
| C | 80 | 20 |
| D | 70 | 30 |
| E | 60 | 40 |
| F | 50 | 50 |

**Legend:**

A – Weaning food formulation made with 100% sorghum flour.
B – Weaning food formulation made with 90% sorghum flour and 10% African yam bean flour.
C – Weaning food formulation made with 80% sorghum flour and 20% African yam bean flour.
D – Weaning food formulation made with 70% sorghum flour and 30% African yam bean flour.
E – Weaning food formulation made with 60% sorghum flour and 40% African yam bean flour.
F – Weaning food formulation made with 50% sorghum flour and 50% African yam bean flour.

## CONCLUSION

Weaning food formulations of acceptable quality were prepared from sorghum / African yam bean blended flours. From the study, it was observed that the weaning food formulations fortified with different proportions of African yam bean flour generally had higher protein, ash and fibre contents than the formulation prepared from 100% sorghum flour. The fortification of weaning food formulations with adequately processed African yam bean flour would improve their nutritional quality and make them meet the protein –energy needs of children in the regions where protein-energy malnutrition is prevalent. Further studies should be carried out on the fortified weaning food formulations to determine their respective protein quality and amino acid profile.

**Table 2:** Means [1,2] of proximate composition of weaning food formulations Prepared from SF and SF: AYBF Blends on moisture free basis

| Samples | Moisture (%) | Nx6.25 protein (%) | Fat (%) | Ash (%) | Fibre (%) | Carbohydrate (%) | Energy (KJ/100g) |
|---|---|---|---|---|---|---|---|
| A | 8.06[a] | 6.84[a] | 0.80[a] | 1.44[a] | 2.12[a] | 86.64[a] | 362.10[a] |
| B | 6.24[b] | 8.64[b] | 0.84[b] | 2.20[b] | 2.42[b] | 82.08[b] | 368.84[b] |
| C | 6.44[c] | 9.62[c] | 0.86[a] | 2.46[c] | 2.68[c] | 80.62[c] | 370.44[c] |
| D | 6.62[d] | 10.76[d] | 0.86[a] | 2.88[d] | 2.86[d] | 78.88[d] | 374.96[d] |
| E | 6.84[e] | 12.68[e] | 0.88[a] | 3.02[e] | 3.12[e] | 77.58[e] | 376.87[e] |
| F | 7.26[f] | 13.44[f] | 0.90[a] | 3.46[f] | 3.62[f] | 75.94[f] | 382.98[f] |

1. Values are means of triplicate determinations.
2. Means with different superscripts within the same column are significantly different from each other ($p<0.05$).

**Table 3:** Means [1,2] of sensory evaluation performed on different samples reconstituted weaning food gruel prepared from SF and SF: AYABF Blends.

| Samples | Colour | Flavour | Texture | Overall acceptability |
|---|---|---|---|---|
| A | 6.0[a] | 8.2[a] | 7.8[a] | 8.6[a] |
| B | 6.6[b] | 7.6[b] | 7.2[b] | 7.8[b] |
| C | 7.2[c] | 7.0[c] | 7.0[c] | 7.2[c] |
| D | 7.8[d] | 6.6[d] | 6.4[d] | 6.6[d] |
| E | 8.0[d] | 6.0[e] | 6.2[d] | 6.0[e] |
| F | 8.6[e] | 5.4[f] | 5.6[e] | 5.8[e] |

1. Values are means of 15 untrained judges.
2. Means with different superscripts within the same column are significantly different from each other ($p<0.05$).

## ACKNOWLEDGEMENT

The author is grateful to Miss J.A. Nnani and Messers A.C. Ikpeama and F.E Ezeka for their support and contribution. The provision of research facilities by the management of Madonna University, Elele Campus, Rivers State, is also appreciated.

## REFERENCES

Achi, O.K. (2005). The potential for upgrading traditional fermented foods through biotechnology. *African Journal of Biotechnology; 4: 375-380.*

Agu, H. O. and Aluyah, E. (2004). Production and chemical analysis of weaning food from maize, soybean and fluted pumpkin seed flour. *Nigeria Journal of Food Science and Technology; 22: 1711-177.*

AOAC (1995). *Official Methods of Analysis*. Association of Official Analytical Cchemists. 16th edn. Washington D. C. Pp. 205-224.

Banigo, E. B., Mepba, H. D. and Duru, S. N. (2004). Pasting characteristics of African yam bean *(Sphenostylis stenocarpa)* starch . *Proceedings of the Nigerian Institute of Food Science and Technology. Pp. 210 –211*.

Chavan, J. K. and Kadam, S.S. (1989). Nutritional improvement of cereals by sprouting. *Critical Reviews in Food Science and Nutrition; 28:421 –437.*

Eke, O. S. (2002). Effects of malting on the dehulling characteristics of African yam bean *(Sphenostylis stenocarpa)* seeds and the functional properties of the flour. *Journal of Food Science and Technology; 39 (4): 406-409.*

Eneche, H. E. (2006). Production and evaluation of cakes from African yam bean and wheat flour blends. *Proceedings of the Nigerian Institute of Food Science and Technology. Pp. 46-47.*

Enwere, N.J. (1998). *Foods of Plant Origin*. Afro-Obis Publications Ltd, Nsukka. Pp. 76-98.

FAO (2005). Food and Agricultural Organization. *FAOSTAT. Http//Faostat.fao.org//.*

Ihekoronye A.I. (1999). *Manual of Small-scale Food Processing*. Macmillan Publishers Ltd, London. Pp. 108 – 212.

Iwe, M.O. (2001). Organoleptic assessment of single-screw extruded mixtures of soy-sweet potato flour by response surface analysis. *Plant Foods for Human Nutrition; 56:324 – 330.*

Iwuoha, C.I. and Eke, O.S. (1996). Nigerian indigenous fermented foods: their traditional process operations, inherent problems, improvements and current status. *Food Research International 29:527 – 540.*

Jipara, P.H., Normah, M.M., Zamaliah, R. and Mohamad, K. (2001). Nutritional quality of germinated cowpea flour *(Vigna unguiculata*) and its application in home prepared powdered weaning foods. *Plant Foods for Human Nutrition; 56:203 – 216.*

Nnam, N.M. (2001). Chemical, sensory and rheological properties of porridges processed from sorghum *(Sorghum bicolor)*, Bambara groundnut *(Vigna subterranea L. verde)* and sweet potato *(Ipomoea batatas)* flours. *Plant Foods for Human Nutrition; 56:251 – 264.*

Nout, M.J.R (1993). Processed weaning Foods for tropical climates. *International Journal of Food Science; 43:213 – 221*.

Okaka, J.C. Akobundu, E.N.T and Okaka, A.N.C (2000). *Human Nutrition: An Integrated Approach*. 2nd edn. Ocjanco Academic Publishers, Enugu. Pp. 176 – 192.

Okoye, J.I., Nkwocha, A.C. and Ezigbo, C.I. (2007). Nutrient composition and microbiological evaluation of weaning food from maize and soybean flour. *International Journal of Biotechnology and Allied Sciences; 2 (2): 179 – 185.*

Onwuka, G.I. (2005). *Food Analysis and Instrumentation*: Theory and Practice. Naphthali Publishers Ltd, Lagos. Pp. 56 – 62.

Onyenekwe, P.C., Njoku, G.C. and Ameh, D.A. (2000). Effect of cowpea processing methods on flatus causing oligosaccharides. *Nutrition Research; 20:349 – 358.*

Powers, J.J, (1998). *Current Practices and Application of Descriptive Methods. In: Sensory Analysis of Foods.* Elsevier Publishers Ltd, London and New York. Pp. 187 – 268.

Thaoge, M.L., Adams, M.R., Sibara, M.M., Watson, T.G. Taylor, J.R.N and Goyaverts, E.M. (2003). Production of improved infant porridges from pearl millet using a lactic acid fermentation step and addition of sorghum malt

to reduce viscosity of porridges with high protein, energy and solids (3%) content. *World Journal of Microbiology and Biotechnology; 19:305 – 310.*

Treche, S. and Mbome, I.L. (1999). Viscosity, energy density and osmolality of gruels for infants prepared from locally produced commercial flours in some developing countries. *International Journal of Food Science and Nutrition; 50:117 – 125.*

Uzogara, S.G., Agu, L.N. and Uzogara, E.O. (1990). A review of traditional fermented foods, condiments and beverages in Nigeria: their benefits and possible problems. *Ecology of Food and Nutrition; 24:267 – 288.*

Received for Publication: 17/08/2009
Accepted for Publication: 15/03/2010

Corresponding Author
Okoye J.I.
19 Uke Street Phase 1 Omagba Layout, P.O. Box 273, Onitsha, Anambra State Nigeria.